30

1391950.-43-44 **File No.** 3822/36

I

B CLASS

P.W **DEPARTMENT**

I **BRANCH**

Subject:— Central Board of Irrigation

Technical notes etc.

E.L.K.-1944

File No. 3822/36-I I. Br

Ed. Secrt. Slip 74 A

G.R., G.D., No. 2408, dated 22-6-22.]

Correspondence

DOCKET SHEET

Subject :—

File No. 3822/36

P. W **DEPT.**

I **BRANCH.**

References :— Original copy sent to Maharashtra

Date.	To whom sent.	Notes and instructions.

Copy of D.O. dated the 18th February, 1939, from R.F. Walter, Esq., Chief Engineer, United Stated Deptt. of the Interior, Bureau of Reclamation, Customhouse, Denver, Colorado to M.T.Gibling, Esq., I.S.E., Secretary, Central Board of Irrigation, Simla.

"Receipt is acknowledge of your letter of December 8, 1938, in regard to losses from unlined canals and the possibility of preventing waterlogging of lands by providing a concrete lining for the canals.

The elimination of seepage and prevention of waterlogging is a complicated matter. Irrigation waters that contribute to waterlogging are comprised of water applied to the land in excess of the plant requirements and soil evaporation, losses from laterals used in the distribution of waters, and losses from main canals. Diverted waters may on the average be segregated about as follows:

Loss by main canals	20%
Loss by laterals	15%
Wasted throught project	5% *
Consumed by plants and soil evaporation	45%
Application to the land in excess of use by plants and soil ..... evapopation	15%

From the above tabulation you will note that on the average only 45% of the water is consumed and 50% of the water goes into the soild to be carried away.

Consists of water returned to the stream, genemally through the canal waste ways, or at the end of the canal system, or as surface run-off from the irrigated lands. In a well managed system, the 5% suggested for "waste" should be adequate to cover also evaporation losses from the canals and laterals.

under ground. Lining of the main canals, if fully effective, would reduce by 40%**, the amounts of water that must be disposed of by ground water flows. Whether the elimination of such main canal losses by lining would fully meet your situation is a matter as to which we could hardly inform you, as it involves amounts of water remaining to be disposed of, the various sources, thereof, and the structure of the soils, subsoils, and underlying strata.

Your experience with water measurements in canals parallels ours. Where it is desired to secure accurate information for the purpose of localizing seepage loss on canals, the determination of losses by current meter measurements is never satisfactory as to large canals.

** The statement "Lining of the main canals, if fully effective, would reduce by 40% the amounts of water that must be disposed of by ground water flows" may be amplified as follows:-

The percentage referred to in this statement is a part of the water that must be disposed of by ground water flows and is not on the same basis as the percentages shown in paragraph 2 of Mr. Walter's letter, which represent parts of the water diverted. It is believed that the following example will clarify this statement. Suppose that a canal system diverts 100,000 acre-feet annually. On the basis of the percentages given by Mr. Walter, this water would be disposed of as follows:

Loss by main canal	20,000	acre feet
Loss by laterals	15,000	" "
Wasted	5,000	" "
Consumed by plants and soil evaporation	45,000	" "
Application to land, in excess of use by plants and soil evaporation	15,000	" "
	100,000	" "

In this case, 50,000 acre-feet (sum of losses by main canal, and laterals, and excess application to the land) of the water diverted by the main canal goes into the soil to be carried away under ground. It will be noted that the main canal loss of 20,000 acre-feet is 40% of this total (50,000 A.F.).

Where it is possible to suspend canal operations, losses can be determined for short sections by means of temporary checks that will permit ponding in desired sections. While such a method will determine local losses, the extent thereof is not a true measure of the need for their elimination. In some localities favourable ground conditions will permit heavy losses ~~favourable ground conditions will permit heavy losses~~ without injury to adjacent lands while in other localities even minor losses result in seepage difficulties. Except where the loss of water becomes an economic matter we have been prone to limit lining to those areas where canal lining is the obvious cure to a seepage situation.

While many miles of canal have been lined with concrete by the Bureau of Reclamation, the capacities have rarely been excess of 2,000 second-feet, with corresponding bottom widths and water depths of 14 feet and 11 feet respectively. Side slopes are usually made 1½ horizontal to 1 vertical. The larger sizes of canals and those of smaller sizes to be exposed to severe climatic conditions are lined with concrete 4 inches thick reinforced with ½ inch round bars at 12-inch centres longitudinally and 24 inch centres transversely. No special provision is made for expansion and no particular trouble with buckling has been experienced. In order to induce contraction cracks at regular intervals and to control their direction, transverse grooves about 5/8 inch deep are provided at from 8 foot to 20 foot intervals.

The grooves as a ove described have not proven entirely effective in controlling cracking and some experiments have been initiated with preformed joints provided with rubber water seals and with the reinforcement

dis - .....

discontinuous at the joints. While the evidence is not yet conclusive, it appears that much of the cracking can be eliminated by such provision.

Much of the recent canal lining has been placed by machines similar to that used on the Colorad. River Aqueduct of the Metropolitan Water District of Southern California, and described in the Engineering News-Record of February 20, 1936.

Recent contract prices for placing concrete lining have ranged from $ 7.00 to $ 8.50 per cubic yard. Under these prices materials are furnished by the Government, but usually hauled from one to three or four miles by the contractor. Reinforcement is also furnished by the Government, but placed by the contractor at a price of one and one-half to two cents per pound.

In general, experience with concrete lining has been satisfactory. Such cracks as have occured apparently seal with silt and are not responsible for any material amount of leakage.

No. 4041 - J.121.

CENTRAL BOARD OF IRRIGATION.

"Sherwood",

Simla, W.C., the 4th August 1939.

Subject:- Losses from Canals and Lining Canals.

Dear Mr. Sule,

I am forwarding herewith for your information a copy of the correspondence recently received from the Chief Engineer of the United States Bureau of Reclamation on the above subject.

Yours sincerely,

Sd/-

To

R. G. Sule, Esq., I.S.E.,
Chief Engineer & Secy. to Govt.,
P.W.D., Irrigation & Rlys.,
Bombay.

D.A.- Copy of letter dated
18th February, 1939,
from R.F.Walter Esq.

3822/36
1863/6

(I.B.)

Submitted for information.

2. The S.E., D.I.C. may see these papers u.o. before they are recorded.

Id/-
9/8/39.

A very useful note - It would be worth which comparing two with an experience in Deccan Canals.

Id/-
4/8

U.O.N. to S.E., D.I.C., dt. 15-8-39.

Below Government (P.W.D.) U.O. No.3822/36
18636

dated the 15-8-1939, regarding losses in transit and lining of canals.

U:O. No.59 of 1939.

Poona, 17th August 1939.

Returned with compliments.

2. The losses found in transit in the Deccan Canals are generally as under:-

(1) Evaporation in lake 8%

(2) Losses in main canal on discharge at headq..... 33%

(3) Losses in distributaries for 3 miles length and Q at head of distributaries 15%

(4) Losses in outlets on Q at heads of outlets 7%

3. Generally speaking only 50% of the water in the water in the storage reaches the field and of this about 20% is excess watering.

4. Regarding lining, due to the low returns g fetched by the Deccan Canals, concrete lining (or any other type of lining for the matter of that) is uneconomical.

Sd/-

Superintending Engineer,
Deccan Irrigation Circle.

(J.B.)

Submitted for information and orders, if any, with reference to the Secy's note dt. 11-8-39.

Id/-
19/8/39.

Id/-
22/8

Resubmitted to the Dy. Secy. for perusal..

Id/-
23/8/39.

Id/-
23/8/39.

Report on Asphalt Revetment and Canal Lining Experiments in Bengal during 1938 by E.A. Moore.

S U M M A R Y.

The experiments have definitely demonstrated that a durable and effective asphalt river revetment can be made up with the materials available in Bengal, the cost being considerably less than that of the usual mass concrete paving, concrete block pitching, stone boulder pitching or the 12" thick wire enclosed loose brick matteress.

The advantages of this type of revetment have already been discussed in detail in my Note on Asphalt Revetment.

In a province such as Bengal having suitable sands and sites easily available and at trifling cost and with asphalt now at a reasonably low price this type of revetment obviously recommends itself for the protection of the many riverside towns now threatened by erosion. It has been thoroughly tested on the Lower Mississippi where since April 1934 more than 17 miles of river bank have been revetted with asphalt paving. On account of its lesser cost and greater effectiveness it is rapidly becoming the standard form of bank protection on that river.

Practically all the revetment necessary in Bengal can be laid in the dry between November and May when the rivers are at low level. There are certain places however, where the reinforced mattress would require to be made up and launched below the water surface from a special casting and launching barge. A barge large enough to prepare a mattress 30 ft. in width would serve our purpose.

As a canal lining the asphalt mixture has obvious points in its favour, the chief being its cheapness as compared with a suitable concrete lining, its flexibility, impermeability and durability. With the small amount of money available for these experiments it has not been possible to do more than the preliminary work in this direction. It appears however to offer such definite possibilities that it would seem well-worth-while for those provinces, in which canal lining is a matter of considerable importance, to experiment further with the .....

and silts locally available and after determining the most suitable mixture then to test a short reach of a canal with an asphalt lining.

Some doubt has been expressed whether an asphalt canal lining will be able to withstand the wide range of temperatures which prevail for example in the Punjab. Assuming a maximum sun temperature of 140° F. the temperature of the asphalt lining would probably reach 160°. At this temperature the mixture using 30/40 penetration asphalt would undoubtedly soften but not sufficiently so to flow. During the closure periods, if in the hot weather, there would perhaps be danger of damage to the lining from cattle, but with canal side slopes of 1½ to 1 or even 2 to 1 this risk would be minimised.

If 30/40 penetration asphalt did not provide sufficient stability an asphalt of 20/30 penetration would undoubtedly do so; the only danger in using the latter being the possibility of cracking during very low temperatures. It would however be well worth testing this lower penetration asphalt and also a mixture in equal proportions of 30/40 and 20/30 asphalt.

As will be gathered from the report the secret of success lies in using the proper grades of sands and filler plus just sufficient asphalt to coat all the particulars and fill all except about 2 to 5% of the void space. As explained in an earlier paragraph for canal lining with water depths exceeding 6 feet not more than 3% voids should be allowed. With unsuitably graded aggregates it would be quite possible to use as much as 20% asphalt and still have a porous mixture.

As to the costs given in the report it will be noted that the experiment rates are reasonably low, but upon a working scale with the use of machinery for mixing and more efficient heating plant they can be considerably reduced.

There .....

There appears to be a wide field for a cheap and effective lining on very small irrigation channels and further experiments with much thinner asphalt linings than these described in this report would seem to be desirable.

It has already been mentioned that the present experiments were carried out under the worst possible weather conditions, with the result that the foundation earth was invariably damp and soft. This undoubtedly prevented effective consolidation by temping and resulted in the compressed mixture being rather more porous than would be the case under dry weather conditions.

Acknowledgement is due to the Standard Vacuum Oil Co. for making the sieve analysis of the various sands and silts tested, for preparing sample briquettes and for their advice and assistance generally during the progress of the experiments.

Sd/- E.A, Moore,

15/9/38

Executive Engineer, Bengal.

SAP/-

No.493 of 1940.

Camp Nasik, 25th January '40

Subject:- Moore's report on asphalt lining.

Memorandum

The undersigned presents compliments to the Deputy Secretary to the Government of Bomby, Public Works Department and with reference to Government Memorandum No.246/36-I. dated 13-1-39 has the honour to return herewith after perusal a copy of the summary of Moore's report on Asphalt Revetment and canal lining experiments in Bengal during 1938.

D.A.

1 Copy of the note
referred to above.

Sd/-

Superintending Engineer, D.I.C.

J.B.

Record

Id/- S.K.P.
5/3/40.

Id/-
6/3/40.

Some notes on Subsoil Irrigation and its value in utilising ablution room sullage water from barrack cook houses from Dhobi Ghats for vegetable gardens, by Brigadier G.Howson, C.I.E., M.C., Deolali.

---

1. The general idea is almost the exact reverse of agricultural drainage. Agricultural drainage is intended to drain water-logged or boggy ground. Subsoil irrigation is designed to give water to plants at the place it is most needed —— that is at the roots.

2. For temporary works and for areas watered with water comparatively free from silt of impurities by far the cheapest method is to use earthenware pipes, diagrams of which are given in Appendix "A". Figs. 1, 4, 5.

For more permanent works and for use with water carrying silt or impurities the use of concrete pipes is recommended. Diagrams of these pipes are given in Appendix "A", Figs. 2 and 3.

3. The cost of the earthenware pipes or tubes vary in different districts according to local conditions. Rates of pay for potters -- accessibility of good clay and the cost of firing materials for kilns.

I had these pipes made in Ajmer when the first experiments were carried out. Once I had trained potters to produce pipes to the design that had proved most satisfactory, I was able to have them delivered within a mile radius from the kiln at Rs.4/8/- per 100 in a famine year when burning material was scarce.

In Deogad Baria in Gujarat I purchased them at Rs.2/8/- per hundred but here the potters had not to pay for the clay.

In Deolali, though clay exists, local potters were poor workmen and lacking in initiative and I had to go to potters in Nasik. Here the cheapest rate has been Rs.6/8/- per 100 but with any enterprise I think it should be possible to get them made in Deolali itself at Ajmer prices Rs.4/8/- per 100.

I had to bring my master potter down from Ajmer to teach the....

the Nasik potters.

It must be remembered that these earthenware tubes can only be made in dry weather as before being fired they have to be sun dried.

The longest pipes that potters can turn is limited to 12 to 14 inches. Clay on the wheel will not stand at a greater height and buckles or bulges.

I had longer pipes made but these were jointed after turning and much more expensive.

4. As regards concrete pipes these have frightened people because of the threatened price based on known costs of Hume pipes. I had pipes made up of a special mixture which proved exceedingly satisfactory and at the same time as porous or even more porous than earthenware pipes.

Their percentage of absorption of water in 24 hours to weight was higher than that of earthenware pipes. These pipes were hand made and cast in a mould costing Rs.50/- for the 3 ft. pipes and Rs.15/- for the 7 inch sleeve pipes.

I found that these pipes would be produced at a profit in lots of 1000 or more at 2 As. a foot. They have the great advantage of being everlasting and of standing up to cleaning out at intervals with wire sewar brushes. They can be made under cover in any weather.

5. There are different methods of use. In the first place the object may be simply to get rid of surplus water irrespective of the fact that this water may be put to far more economical use by using lines of subsoil pipes to water a wide area. From experience it has been found that grass and cereals in the driest and hottest areas only need subsoil irrigation once in every three or four days.

Vegetables and lucerne once every two or three days.

If therefore funds will stand the initial outlay a return on capital outlay of at least 40% per annum can be expected on crops and vegetables. Experiments with lucerne and tomatoes resulted in a return 100% in eight months.

Experiments with grass proved that perfect grass for grazing, cattle and horses can be provided all the year ....

year round except during the Monsoon.

The top surface is dry. There is no puddling or caking of the top surface and no weed.

Buffaloes cannot be grazed over subsoil irrigation as they appear to smell the water underground and start kneading for it.

6. For utilising sullage water - water from abulition rooms and from Dhobi Ghats care has to be taken to prevent the entry into the pipes of too heavy a charge of soap, of grease or of bits of food or rice from cook houses.

This is not difficult provided that due care is exercised by the Conservancy staff. A special pattern of tin has been devised into which all water from the cook house, Dhobi Ghat or ablution room passes. This tin contains grass or straw and the contents of this are tipped into ashbins as required.

Water coming out of this tin flows into the small cistern containing the tin and thence through what are known as Nahini traps into the subsoil pipes. An alternative is to use removable grids of G.I. but these are not so satisfactory as sweepers are tempted to take them out to let refuse and water get into the subsoil pipes.

Sketches showing these systems are given in Appendix "B".

The more straining devices that can be fitted between the sink and the entry into the pipes the better. It is quite easy to fit a grid or two in the drains round Dhobi Ghats. These hold up a great quantity of soapy sediment, but they are not absolutely essential.

I have tried many alternatives. Much depends on the lie of the ground.

7. The laying of the pipes and the planing of the trenches to carry the pipes is a matter of commonsense. There are certain mistakes that have to be guarded against:-

(a) These jointed pipes must never be looked on as closed pipes. Nothing in the nature of a syphon must be tried.

Though ....

Though the pipes are in the ground water in them will not regain its own level beyond the syphon or dip but will flood to the surface above the depression or syphon.

It follows that the bottom of the trench must be a continuous straight or series of straight lines as shown in Fig. i, Appendix C.

It is a very simple matter to test this by letting water into the trench before laying the pipes. This by lying in puddles will show all depressions and these must be filled up.

No instruments, levels or theodolites are needed.

(b) If from the lie of the land water has to be taken down a fairly steep incline before reaching more level ground that is to be irrigated it is better to close the unions of the last two or three pipes at the bottom of the run and the first two or three pipes on the level ground with quick drying cement to prevent the head of water from forcing water to the surface as the check of the flow is felt.

(c) If there is a drop of level to be negotiated this can be arranged with ease as shown in Figure 2 in Appendix "C".

(d) Before pipes are laid they must be tapped to make certain that they are not cracked or damaged.

(e) Once pipes are laid the trench should be filled in which powdered or wall disintegrated earth till only the upper edge of the pipe remains visible.

More earth of the same soil should be prepared along the edge of the trench.

Water can t en be let into the pipes and as damp earth shown at consecutive joints earth is thrown in to cover the pipes. This is only a precautionary measure to make certain that water is flowing smoothly and easily down the pipe. From experience it has been found that if due care is taken when pipes are being laid nothing goes wrong but that carelessness at this stage always leads to trouble later on.

Once the pipes have been tested the whole trench can then be filled in. Care should be taken not to fill in with big clods or stones. If any charcoal dust or manure, rotted or

unrotted ....

unrotted, is available it may as well be put in after the pipes have been cover d over with about 3 inches or more of earth.

This strengthens the soil.

8. Approximately 15 inches below ground level has been found by experience to be suitable depth for economical use. Water will rise to greater hights than this by capillary action, but it is uneconomical to big deeper trenches than this.

Ploughing, with pipes at this depth is safer and the heaviest lorry or trucks will not have the slightest effect on pipes sunk to this depth. In an experiment it was found that 6 inches of earth gave sufficient protection against 3 ton lorries over the trenches at right angles.

9. The amount of lateral spread water from subsoil irrigation depends on a variety of factors. In very dry soil the spread is slow and 3 to 4 feet on either sid is all that can beexpected.

A fall of one inch or more of rain results in a doubling of this lateral spread as the lateral capillary action is increased at once and soil once damp appears to remain damp so long as water flows through the subsoil pipes once every third or fourth day. The extreme lateral spread I have found so far in light sandy soil with some clay below the light soil has been 24 feet.

For lawns I have had excellent results with pipes laid at 8 foot intervals. For lucerne with pipes at six foot intervals. Vegetables will grow excellently on any ground within 1 feet,6 inches on either side of a drain. I have not tried them with pipes 4 foot apart but think this would give good results.

10. In Appendix "A" I have shown different patterns of pipes that have been used. These are all of very simple construction.

The step cock only cost 8 annas complete with guard and

was ....

was very successful when parallels had to be watered off one delivery main as shown in Appendix "C" Fig. 3.

11. It is, in my opinion, very important that there should be a vent at the end of each line of pipes. These vents are invaluable for inspection purposes as they show whether water is reaching the end of the subsoil drain or not.

Secondly they prevent the possibility of an airlock in the drain and thirdly they allow of the ingress of fresh air down the full length of the drain when there is no water in the drain. This fresh air must airate the subsoil by following the water as it soaks away through the joints and has, I believe, some action in preventing roots getting into the pipes for roots do not seem to thrive when exposed to fresh air.

12. Too much stress cannot be laid on the fact that pipes must be well baked in the kiln. Indifferently baked pipes disintegrate or fall to pieces after being underground for a month or two. Well baked pipes will last for years.

Central Board of Irrgn. 21.4.43.

APPENDIX A

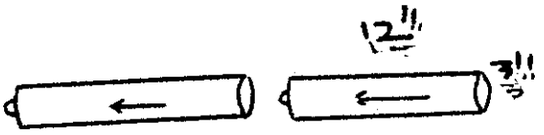


Fig 1

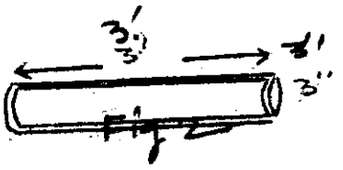


Fig 3

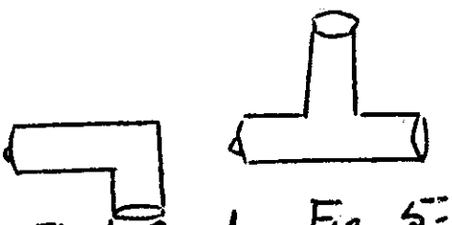
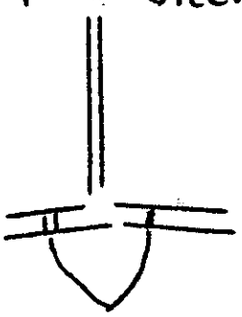


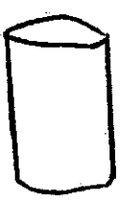
Fig 4 Band

Fig. 5 T. Piece

Sleeve which slides over the ends which touch each other in the centre of the sleeve.



Stop Cocks

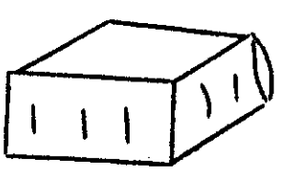


Cover

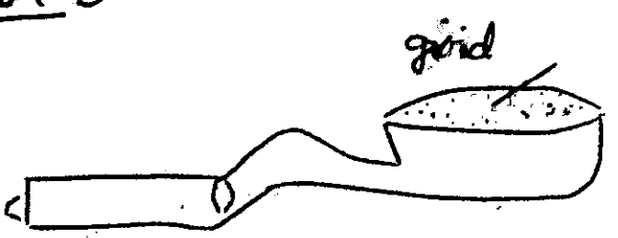
Plug. fits in here

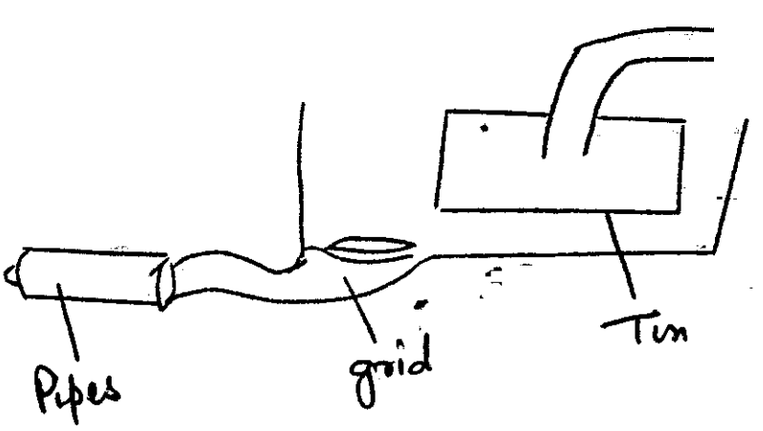
Plug.

APPENDIX B



Tin grease trap
Slots 1/8" wide
Dry grass inside.





APPENDIX C

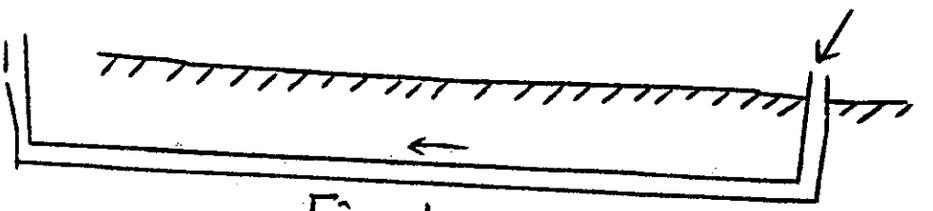
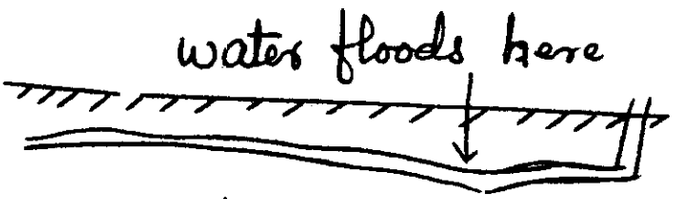


Fig. 1



Syphon Wrong

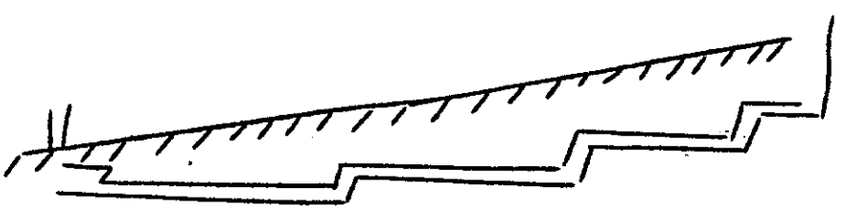


Fig 2

No.1895 - J.101.

Central Board of Irrigation.

"Kennedy House",

Simla S.W. the 22nd April 1943.

Dear Mr. Daftary,

At Lt.-Col. Lacey's suggestion I send you herewith a copy of a note on subsoil irrigation by Brigadier Howson. Lt.-Col. Lacey considers that the method has possibilities in bhur or sandy soil and would be of great advantage on schemes where water is paid for by volume, notably on tube wells. The chief merit is that village potters can turn out all pipes required very cheaply.

If you decide to give the method a trial, I should be glad to hear the results.

Yours sincerely,

To/

G.D. Daftery, Esquire, I.S.E.,
Chief Engineer & Secy. to Govt.,
P.W.D., Bombay.

D.A.- Note.

5822/36
8757

(J.B.)

Submitted.

2. The S.E., D.I.C. may perhaps be requested to give the method a trial and communicate the results to Govt.

Id/-
29/4/43.

Thro. A.E.

The papers may be sent to the S.E., D.I.C. for information U/O. He may give a trial - the report to Govt.

Id/-
30/4/43.

Id/-
30/4/43.

U.O.R. to the S.E., D.I.C., dt. 4/5/43.

Below U.O.R. dated the 4-5-43 from Government in the Public Works Department.

U.O.No. 27.

Poona, 19th May, 1943.

Returned, with compliments.

2. The Executive Engineers in this Circle have been requested to give the method a trial and communicate the results to this office. A report in the matter will submitted to Government in due course.

Sd/-

Superintending Engineer, D.I.C.

3822/36
11504

J.B.

Await.

Id/-
24/5/43.

Id/-
24/5/43.

J.B.

The S.E., D.I.C., expedited under No.3822/36-I, dated the 10th June 1944.

Id/-
16/6/44.

SAP/-

No.3554 Letter.

DECCAN IRRIGATION CIRCLE

Poona, 21st June 1944.

To

The Executive Engineer, Poona Irrigation & Res. Division
Nira Canals Division.

Subject: Subsoil Irrigation.

Reference: this office U.O. No. 26 dated the 15th May 1943.

Your attention is invited to this office number quoted above nd you are requested to submit, without delay, a report in the matter referred to therein. If any more delay is likely the probable date on which the report may be expected should please be stated for the information of Government.

Sd/-

Superintending Engineer, D.I.C.

Copy forwarded, with compliments, to the Deputy Secretary to the Govt. of Bombay, P.W.D. with reference to the G.M. No.3822/36-I dated the 16-6-44.

3822/36/17408

L.B.

Await.

Id/-
24/6/44.
26

Id/-
28/6/44.

SAP/-

No.5508. Letter. Deccan Irrigation Circle.

Poona, 2nd October 1944.

To - The Deputy Secretary to the Government of Bombay,

P. W..D.

Subject:- Subsoil Irrigation.

Reference G.M.No.3822/36-I dated the 16th June 1944.

In order to give the method of a trial as instructed in para. 2 of U.O. dated the 4th May 1943, a plot 60'x30' is prepared just adjacent to the septic tank at the end of sewage gutters at Malegaon Colony in Pandhara Sub-Division of the Nira Canals Division, with round tiles used in the trenches connected to the tank, as per instructions in the note of Brigadier G.Howson, C.I.E., M.C., Deolali. Vegetables are grown in the plot and are so far found to be satisfactory.

2. There are no facilities for conducting the experiments anywhere else in the Circle.

Sd/-

Superintending Engineer, D.I.C.

J.B. 3822/36
27644

Submitted with refce. to U.O. note dated 4-5-1944. S.E's report on the experiment conducted in his Circle of sub-soil irrigation according to the method of Brigadier. However sgn is given in his letter overleaf. It is for consideration whether the result of the experiment as reported by the S.E. can be considered satisfactory so as to be communicated to Mr. Thomas.

Id/-
3/10/1944. Thro' A.E.(I)

2. A draft D.O. is put up for approval.

Id/-
4/10/44.

See p. 16

SAP/-

D.O. No.3622/36-I.

P.W.D.,
Secretariat,
Bombay, 4th Oct. 1944.

Dear

Reference your D.O. No.1895-J-101 dated the 22-4-43.

The method of subsoil irrigation suggested by Brigadier Howson was given a trial in a small plot of land measuring 60' x 30' adjacent to the septic tank at the end of the sewage gutters at Malegaon Colony on the Nira Left Bank Canal. Round tiles were laid in the trenches as per instructions of Brigadier Howson. Vegetables were grown in the plot. These so far appear to be satisfactory.

There are no facilities for conducting an experiment on a large scale anywhere else. I do not think the method is likely to find favour with consumers of water on a volumetric basis on the major irrigation works in this Province on account of the prohibitive cost and the extensive works necessary to effect irrigation on the lines suggested. There are no tube wells used for irrigation in charge of this Department.

Yours sincerely,

To

A. R. Thomas, Esq., B.Sc., I.S.E.,
Secretary,
Central Board of Irrigation,
"Kennedy House,"
Simla, S.W.

I think the proposal can have no practical utility at all except perhaps where from idle labour is available. The cost of earthen pipes alone for an acre would be nearly Rs.300/- and the cost of digging trenches & refilling them would, under the most favourable circumstances, be not less than Rs.150 - 200. Also these ~~papers~~ pipes laid at a depth of only 15 inches, may get damaged in ploughing operations.

However the D.O. may reply as proposed may issue.

I/-
5/10/44.

I agree,

Id/-
9/10/44.

D.O. to issue. Id/-
11/10/44.